



CTN Test Report
89-014

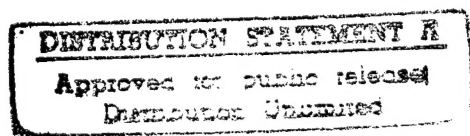
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**Engineering Drawing
Transfer Test Between Tracor and
NAVSEACOMBATSYSSENGSTA:
MIL-D-28000 Class II (IGES)**



October 10, 1989



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Prepared for
Air Force Logistics Command
AITI Project



Lawrence Livermore National Laboratory

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Transfer Test Between Tracor and
NAVSEACOMBATSYSSENGSTA:
MIL-D-28000 Class II (IGES)**

Prepared by
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October 10, 1989

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Contents

Preface	iv
Executive Summary	vi
 1 Introduction	 1
 2 Test Conditions and Procedures.....	 2
2.1 Test Data	3
2.2 Test Platforms	3
2.3 Test Procedures	4
 3 Test Results	 7
3.1 Transmission Envelope	7
3.1.1 1840A Declaration Files and Header Fields	7
3.1.2 28000 Class II Start Section	8
3.2 Processing of IGES/28000 Class II Data	8
3.2.1 End-to-End Transfer Using the Actual.....	8
Engineering Drawing	
3.2.1.1 28000 Conformance of AutoCAD's IGES	44
3.2.1.2 Correct Syntax of AutoCAD's IGES	44
3.2.1.3 Correct Graphics of AutoCAD's IGES	44
3.2.1.4 Correct Display of Graphics by Anvil	45
3.2.2 Preparatory CTN Reference Drawing Testing	45
 4 Conclusions and Recommendations	 47
 Appendix A- Plots of CTN 28000 Reference Drawings	 49
Appendix B- Results of Preparatory End-to-End Testing	55
Appendix C- Results of Preparatory Single-Ended Testing	73
Appendix D- References	91

Preface

The following people are acknowledged for their contribution to this test and test report: Glenn Wright, David Sadler, Michael Firnstahl, Christopher Platt, and Edmond Haddad of the Naval Sea Combat System Engineering Station; Fred Cleveland and Tony Colozzi of Manufacturing and Consulting Services, Inc.; Stephen Metzger and Albert Bordeleau of Tracor Applied Sciences, Inc.; and Kevin Dillon, Christopher Conrad, Bob Elman, and Gary Adams of Autodesk, Inc.

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CTN Test Report 89-014
October 10, 1989

Executive Summary

The DoD Computer-aided Acquisition and Logistic Support (CALS) Test Network (CTN) is conducting tests of the military standard for the Automated Interchange of Technical Information, MIL-STD-1840A (1840A), and its companion suite of military specifications. This test was an end-to-end test between Tracor Applied Sciences, Inc. (Tracor) of Groton, CT, and the Naval Sea Combat System Engineering Station (NAVSEACOMBATSYS-ENGSTA - here on referred to as the Engineering Station) of Norfolk, VA. Tracor transferred Initial Graphics Exchange Specification (IGES) engineering data to the Engineering Station in accordance with the CALS Standards 1840A and MIL-D-28000 (28000). The test's objective was to study the engineering drawing subset of IGES entities defined in 28000 and to introduce the participants to the concept of IGES/28000 testing.

The results were informative. Tracor's AutoCAD Computer Aided Design (CAD) system was able to transfer actual engineering drawings to the Engineering Station's Anvil 5000 CAD system using IGES. The data transferred well except for some enlarged text and a few misplaced graphics. In addition to these results, the test also pinpointed several CAD system deficiencies in meeting 28000. Finally, the test highlighted the need to correct some ambiguities in the standards and to broaden 1840A's transfer media requirements (Tracor delivered on floppy disks, not 9-track tapes). On the basis of this test it is recommended that:

1. CTN technical staff suggest modifications to the Office of the Secretary of Defense (OSD) CALS Policy Office on 1840A in the areas of multiple engineering sheet identification and transfer media requirements.
2. The OSD CALS Policy Office look into a new subset or application protocol to allow microcomputer-based CAD systems to become more easily CALS compliant.
3. The CAD vendors involved in the test continue to improve their IGES processors to 1840A and 28000 levels.

Summary of MIL-STD-1840A Testing - Tracor to the Engineering Station

Tracor's Creation and Delivery

Ability to Write Transmission Envelope

ANSI Level 3 Tape	Part
MIL-STD-1840A Format	Part
Declaration Files	Pass
Header Records	Pass

Ability to Pre-process IGES

Process IGES	Part
Process 28000 Class II Compliant Entities	Part

The Engineering Station's Acceptance and Use

Ability to Read Transmission Envelope

ANSI Level 3 Tape	N/A
MIL-STD-1840A Format	Pass
Declaration Files	Pass
Header Records	Pass

Ability to Post-process IGES

Process IGES	Part
Process Entire 28000 Class II Subset	Part
Produce a Good Image	Part

Pass = Compliant in all respects
Part = Noncompliant, still usable
Fail = Noncompliant, unusable
N/A = Not applicable, because Tracor delivered on floppy
disk rather than ANSI tape

1 Introduction

The DoD Computer-aided Acquisition and Logistic Support (CALS) Test Network (CTN) is conducting tests of the military standard for the Automated Interchange of Technical Information, MIL-STD- 1840A (1840A) [OSDA88] and its companion suite of military specifications. The CTN is a DoD sponsored confederation of voluntary participants from industry and government, managed jointly by the technical staff at Air Force Logistics Command (AFLC) and Lawrence Livermore National Laboratory (LLNL). The objective of the CTN tests is to demonstrate and evaluate the interchange and functional use of digital technical information between industry and government using the CALS Standards. This test studied, in particular, the Engineering Drawing Subset (Class II) of Initial Graphics Exchange Specification (IGES) [NBS88] entities defined in the military specification for the Digital Representation for Communication of Product Data: IGES Application Subsets, MIL-D- 28000 Amendment 1 (28000) [OSDD88].

The CTN conducted this end-to-end test between Tracor Applied Sciences, Inc. (Tracor) of Groton, Connecticut, and the Naval Sea Combat System Engineering Station (NAVSEACOMBATSYS-ENGSTA - here on referred to as the Engineering Station) of Norfolk, Virginia, on May 8-12, 1989 [CTN89]. The test was conducted to demonstrate and test the transfer of IGES data using the CALS Standards 1840A and 28000.

The staff at the Engineering Station asked to participate in this CTN test because they wanted to: (1) gain knowledge of 1840A and IGES/28000 testing enough to develop in-house tests, (2) gain knowledge to use these in-house tests on the bidding of future contracts, and (3) gain information on the IGES/28000 processing ability of their own Computer Aided Design (CAD) system.

2 Test Conditions and Procedures

2.1 Test Data

The CTN technical staff utilized two sets of data for the test between Tracor and the Engineering Station. The first set, the CTN MIL-D-28000 Class II Reference Drawings, "N-entity" and "L-bracket", were used to test each individual CAD system's abilities and to lay the groundwork for understanding when and why problems occurred. These reference drawings are found in "The CALS Test Network MIL-D-28000 Class II Reference Drawing Packet" [FARR89]. They contain every entity identified by 28000 Class II and are displayed in Appendix A of this report.

The second and most important set of data consisted of four sheets, saved as separate parts therefore separate IGES files, of an actual engineering drawing drafted by Tracor. The four sheets were Installation Control Drawings for the AN/SQQ-89(V) Surface Ship Anti-Submarine Warfare Combat System, an integrated system consisting of sonar and fire control systems. Plots of the drawings are displayed in the results section of this report.

2.2 Test Platforms

All testing at Tracor was undertaken on an Autodesk Inc. AutoCAD Release 10 CAD system operating on a Leading Edge 286 personal computer.

The Engineering Station's system was its Manufacturing and Consulting Services (MCS), Inc. Anvil 5000 Revision 1.2.5 CAD system operating on a VAX 8530 computer with a Tektronix 4111 terminal.

The CTN analysis was conducted using the IGES Data Analysis Parser/Verify Software, the Glatz Associates IGES Model Testing System, Rosetta Technologies PreVIEW Package, and visual inspection.

2.3 Test Procedures

The specific test procedures for the transfer test between Tracor and the Engineering Station, and the Engineering Station's study of its own CAD package's IGES translators are as follows:

For the end-to-end test using the actual engineering drawing:

1. Tracor chose four sheets, stored as separate AutoCAD drawing files, of an actual engineering drawing. These four sheets were then plotted, pre-processed to separate IGES files, and written to floppy disks following 1840A procedures where ever possible.
2. Tracor delivered the floppy disks to the CTN for evaluation and to the Engineering Station for acceptance.
3. The Engineering Station post-processed into Anvil, displayed, and plotted the four actual engineering sheets and then examined the CAD databases for missing graphics.
4. The Engineering Station delivered the plots to the CTN for analysis.

For the preparatory testing to pre-evaluate each system's performance using the CTN Reference Drawings:

1. Tracor followed the generation scripts to create the "N- entity" and "L-bracket" drawings on AutoCAD, plotted the graphics, pre-processed the IGES files, and wrote the files to 1840A-like floppy disks.
2. Tracor delivered the floppy disks to the CTN for evaluation and to the Engineering Station for acceptance.

3. The Engineering Station post-processed the IGES files into Anvil, plotted the graphics, and answered the questions listed in the evaluation scripts about the "N-entity" and "L-bracket" drawings.
4. The Engineering Station delivered all evaluation scripts and plots to the CTN for analysis.
5. The Engineering Station created the "N-entity" and "L-bracket" drawings on Anvil, plotted the graphics, pre-processed the IGES files, and sent all data to the CTN for analysis.
6. The Engineering Station received the "N-entity" and "L-bracket" reference IGES files on 1840A tape from the CALS Test Network, post-processed them into Anvil, answered the evaluation scripts, plotted the graphics, and delivered all data to the CTN for analysis.

3 Test Results

3.1 Transmission Envelope

In general, Tracor was able to write the 1840A transmission information and the Engineering Station was able to read it, but one major deficiency existed in the 1840A transfer, the media on which the data was delivered. 1840A calls out that the data be delivered primarily on 9-track tape, but in the case of Tracor and other subcontractors who use only microcomputer-based CAD systems, this requirement is difficult to meet. In this test, for example, Tracor delivered the data on floppy disks. Other organizations wishing to deliver CALS data through telecommunications or other media are facing a similar problem. The CTN technical staff feels this media restriction is unnecessary and recommends that 1840A's discussion of computer media be removed from the document and placed in one or more separate specifications referenced by 1840A. These new specifications should call out and control more types of transfer media than just 9-track tape.

3.1.1 1840A Declaration Files and Header Fields

Because of the makeup of one set of data, one engineering drawing comprised of four sheets saved as different IGES files, Tracor was unsure how to complete the source system and destination system document identifiers found both in the declaration files and header fields. The problem is that 1840A does not clearly specify what is required in these identifier fields, the computer file names or the actual document/drawing names, and this ambiguity should be removed. Furthermore, Tracor was confused because 1840A did not make it clear how to identify that the engineering drawing was made up of four related drawing sheets. The solutions to these problems will be looked into as CTN testing continues and as other tests bring up similar problems. The direction seems to be toward modifying 1840A to require both the computer file names and the actual document/drawing names, both allowing a sheet number.

3.1.2 28000 Class II Start Section

28000 requires that the sending organization enter certain information into the Start Section of the IGES files, for example information to identify the drawing, its date of translation, the performing organization, and more. However, because AutoCAD does not allow the user to enter his/her own Start Section information, Tracor was unable to meet this requirement. This leads to the recommendation that all CAD systems be capable of allowing the user to create his/her own Start Sections.

3.2 Processing of IGES/28000 Class II Data

3.2.1 End-to-End Transfer Using the Actual Engineering Drawing

Table 1 summarizes the results of the end-to-end test using the four sheets of the actual Installation Control Drawing. The table is divided into two main sections: the translation from Tracor's AutoCAD drawing format to the IGES file and from the IGES file to the Engineering Station's Anvil display. The pre-processed IGES files from AutoCAD were evaluated in three areas: AutoCAD's ability to write files that conformed to 28000 Class II, had correct IGES syntax, and represented the correct graphics. The post-processing and display of the IGES file was evaluated in only one area, the correct display of the IGES file's graphics on the Anvil system. The table's "Y"s and "N"s answer the general questions yes or no, and the "X"s denote that the drawing sheet had that particular problem and that the problem was attributed to that particular item.

Plots of Tracor's actual engineering drawing (Sheets 1, 2, 3, and 4) follow the table; keep in mind that they are test drawings and not officially released. The plots are displayed in numerical order and, furthermore, in order of translation. The first plot of each set is Tracor's original drawing (no translation). The second is the graphics that were contained in the IGES file pre-processed by

Tracor's AutoCAD system (one translation). The third is the Engineering Station's Anvil display of the IGES file (two translations). Overall, the graphics transferred well and the Engineering Station could have utilized the CAD drawings with only minor clean up if this had been a production transfer.

Table I

Results from the End-to-end Transfer of the Actual Engineering Drawing Sheets

Engineering Drawing Sheet Number			1	2	3	4
From AutoCAD Format to IGES Format						
Conform to Class II?	Yes/No?		N	N	N	N
	Conformance Errors	Drawing Entity missing	X	X	X	X
		Drawing Properties missing	X	X	X	X
		Illegal text font present	X	X	X	X
		Illegal Composite Curve Entity	X	X	X	X
	If problem, where attributed	IGES Specification				
		28000 Specification				
		AutoCAD pre-processor	X	X	X	X
		Tracor computer operator				
Correct IGES syntax?	Yes/No?		N	N	N	N
	Syntax errors	Line Font DE Fields incorrectly set	X	X	X	X
	If problem, where attributed	IGES Specification				
		28000 Specification				
		AutoCAD pre-processor	X	X	X	X
		Tracor computer operator				
	Correct graphics?	Yes/No?		N	N	N
Graphical Problems		Title block text oversized	X	X	X	X
		Shading not correctly filled			X	X
		Small arrowheads not filled	X	X	X	X
		Special characters incorrectly written	X	X		
		IGES Specification				
		28000 Specification				
		AutoCAD pre-processor	X	X	X	X
		Tracor computer operator				

Table I Continued

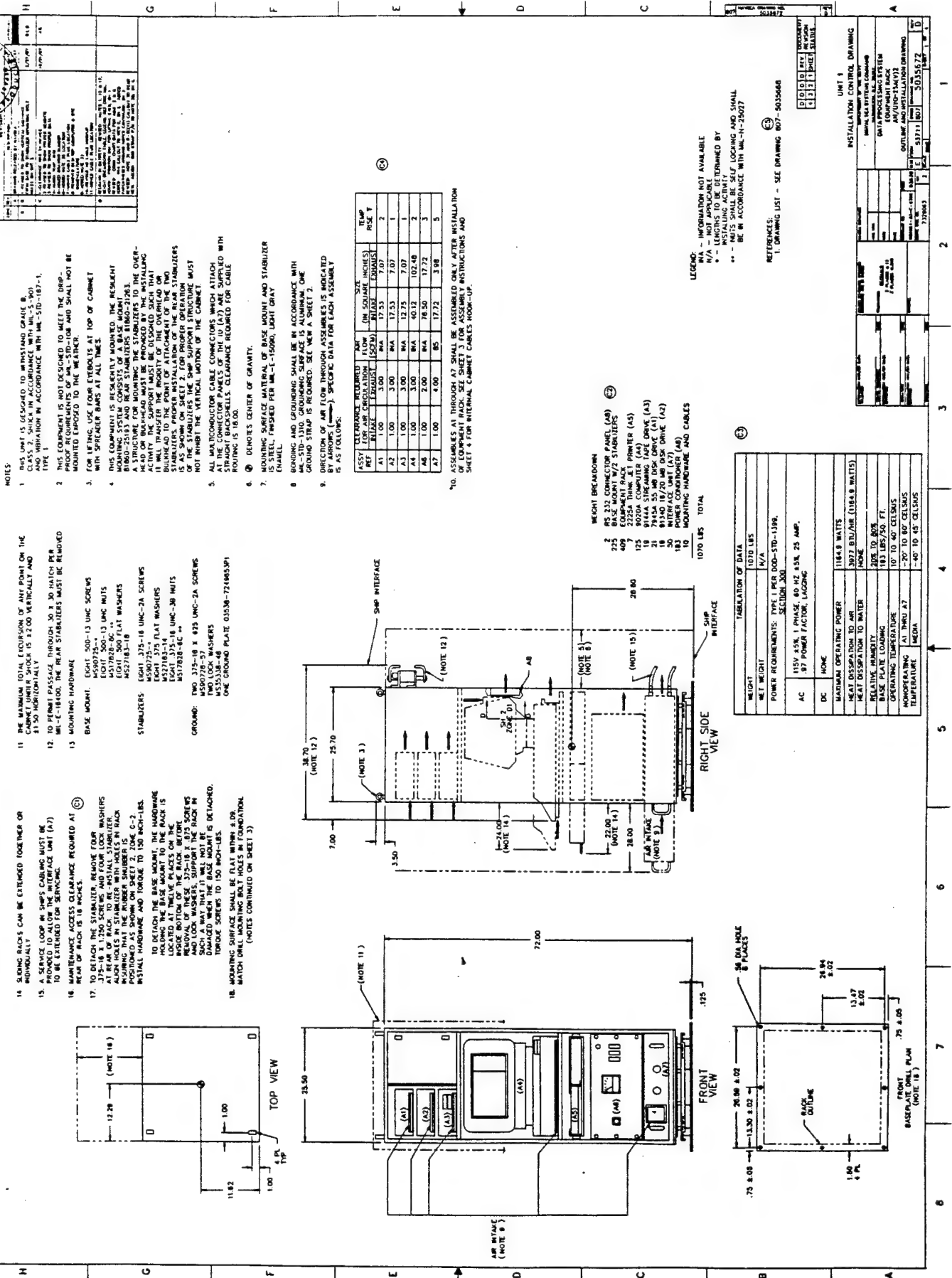
Engineering Drawing Sheet Number			1	2	3	4
From IGES Format to Anvil Format (End-to-End)						
Correct Graphics?	Yes/No?		N	N	N	N
	Graphical Problems	Title block text oversized	X	X	X	X
		Shading not correctly filled			X	X
		Special characters incorrectly written	X	X		
		Circles around textural notes missing	X	X		
		Large filled arrows missing	X			
		Small arrowheads missing	X	X	X	X
		Various other details saved as subfigures missing			X	X
	If problem, where attributed	IGES Specification				
		28000 Specification				
		AutoCAD pre-processor	X	X	X	X
		Anvil post processor	X	X	X	X
		Tracor computer operator	*	*	*	*
		Engineering Station computer operator				
Overall usable data?			Y	Y	Y	Y

* Graphical appearance of transfer could be improved if operator exploded all entities.

Sheet 1

The following three plots are:

1. Installation Control Drawing Sheet 1 as originally drawn by Tracor on AutoCAD.
2. Sheet 1 graphics as stored in the IGES file pre-processed by Tracor's AutoCAD.
3. Sheet 1 as displayed by the Engineering Station's Anvil system after post-processing the IGES file.

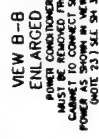
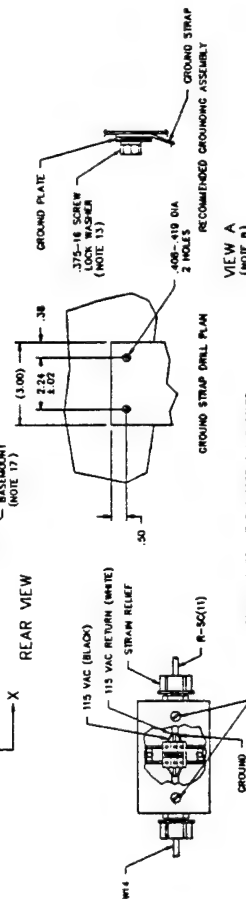
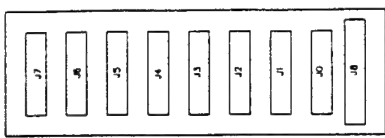


Sheet 2

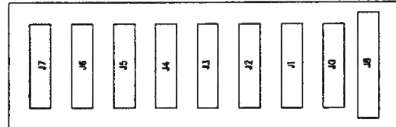
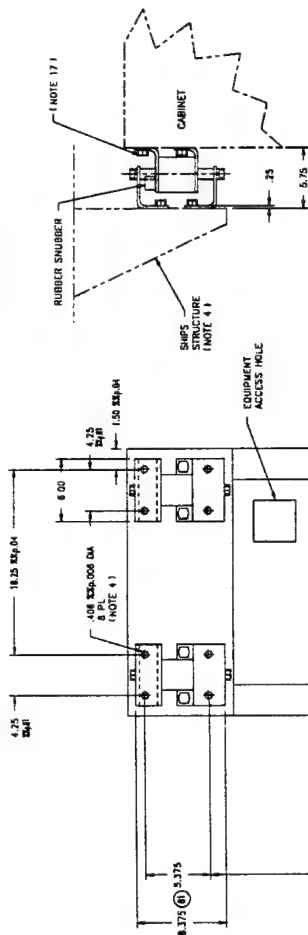
The following three plots are:

1. Installation Control Drawing Sheet 2 as originally drawn by Tracor on AutoCAD.
2. Sheet 2 graphics as stored in the IGES file pre-processed by Tracor's AutoCAD.
3. Sheet 2 as displayed by the Engineering Station's Anvil system after post-processing the IGES file.

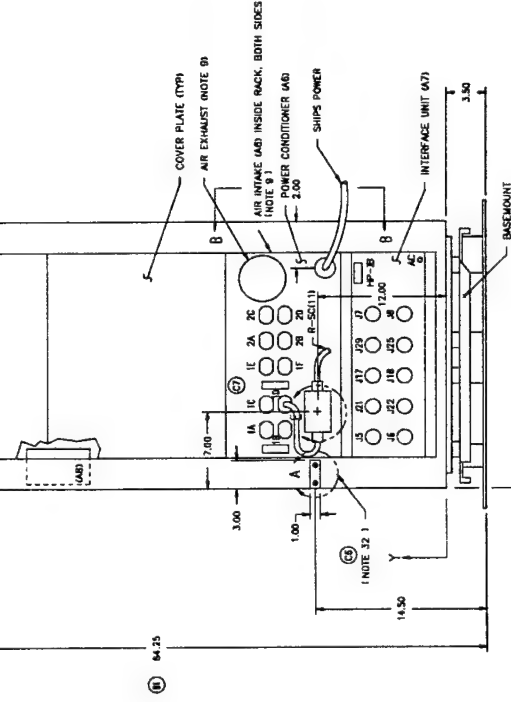
1896



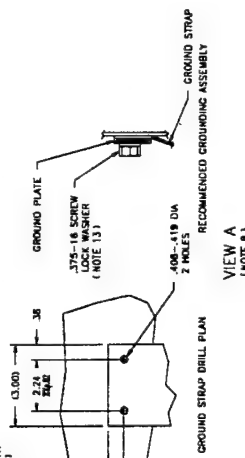
CONNECTOR CHART				
REF	TYPE	F	Y	BACKSHELL
A7/5	M28840/12M151	5.12	6.78	M28840/16M1P1
A7/6	M28840/16M1P1	5.12	3.50	M28840/613WA
A7/8	M28840/16M1P1	16.12	3.50	
A7/17	M28840/16M1P1	10.82	6.78	
A7/18	M28840/16M1P1	10.82	3.50	
A7/21	M28840/16M1P1	7.87	6.78	
A7/22	M28840/16M1P1	7.87	3.50	
A7/25	M28840/16M1P1	13.37	3.50	
A7/26	M28840/16M1P1	13.37	6.78	
A7/27	M28840/16M1P1	16.12	6.78	
A8/0	M28840/16M1P1	3.00	37.60	
A8/1	M28840/16M1P1	3.00	36.77	
A8/2	M28840/16M1P1	3.00	36.65	
A8/3	M28840/16M1P1	3.00	42.53	
A8/4	M28840/16M1P1	3.00	41.42	
A8/5	M28840/16M1P1	3.00	42.26	
A8/6	M28840/16M1P1	3.00	43.16	
A8/7	M28840/16M1P1	3.00	44.03	
A8/8	M28840/16M1P1	3.00	37.00	



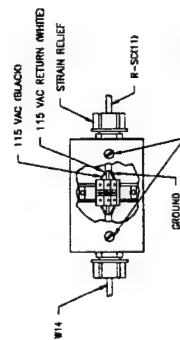
VIEW D-D
AB CONNECTOR LOCATIONS
SH 1 ZONE D3



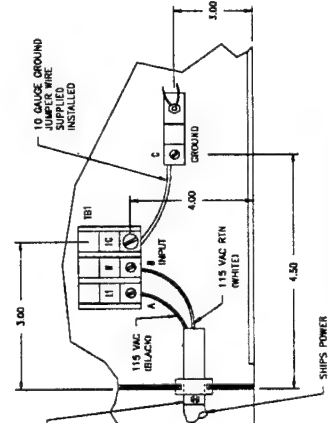
REAR VIEW



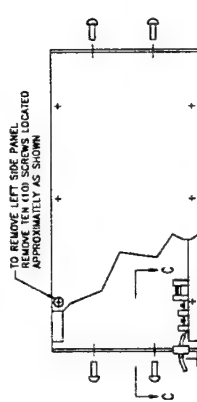
VIEW A
NOTE 8



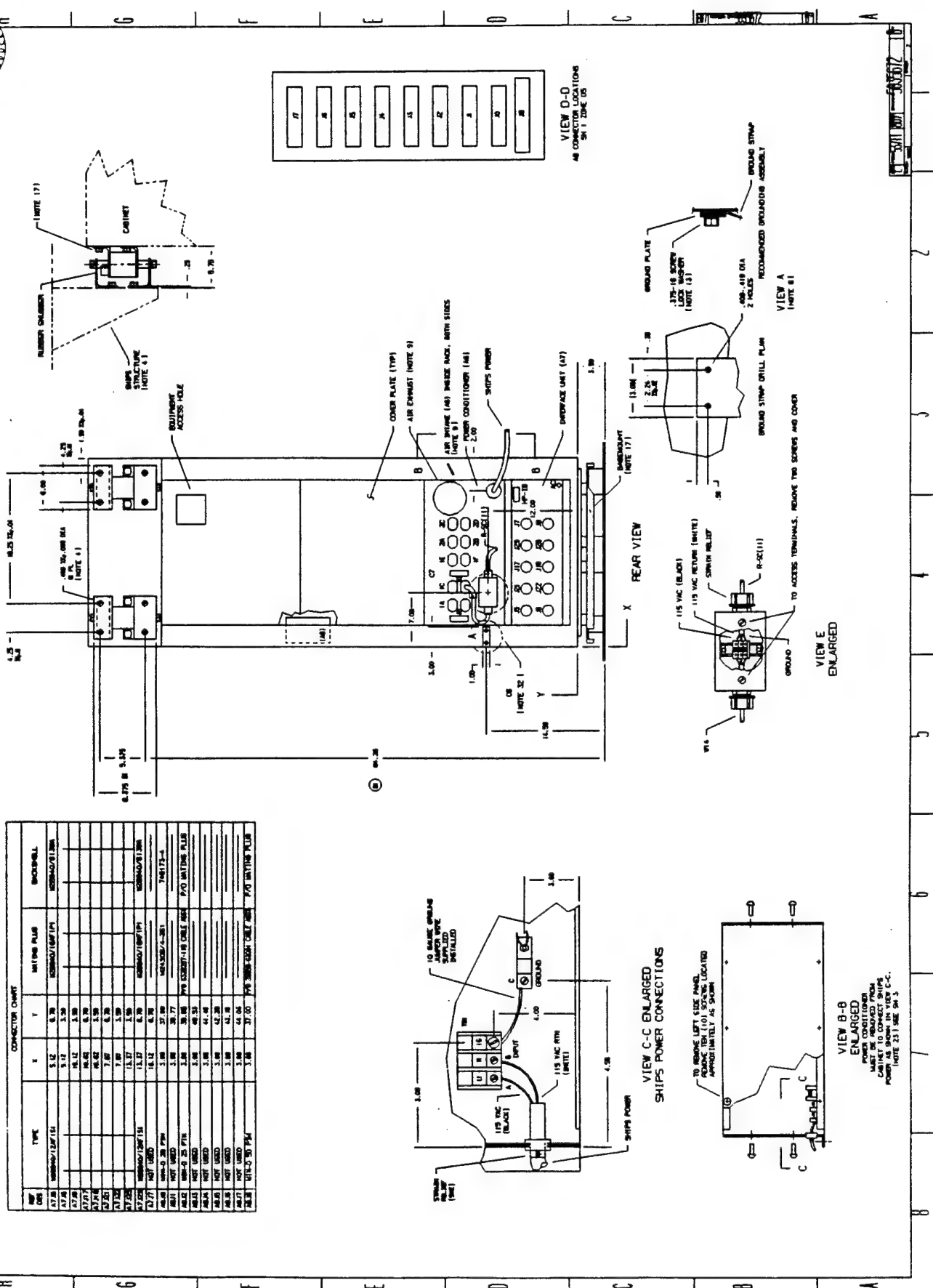
VIEW E
ENLARGED



VIEW C-C ENLARGED
SHIPS POWER CONNECTIONS



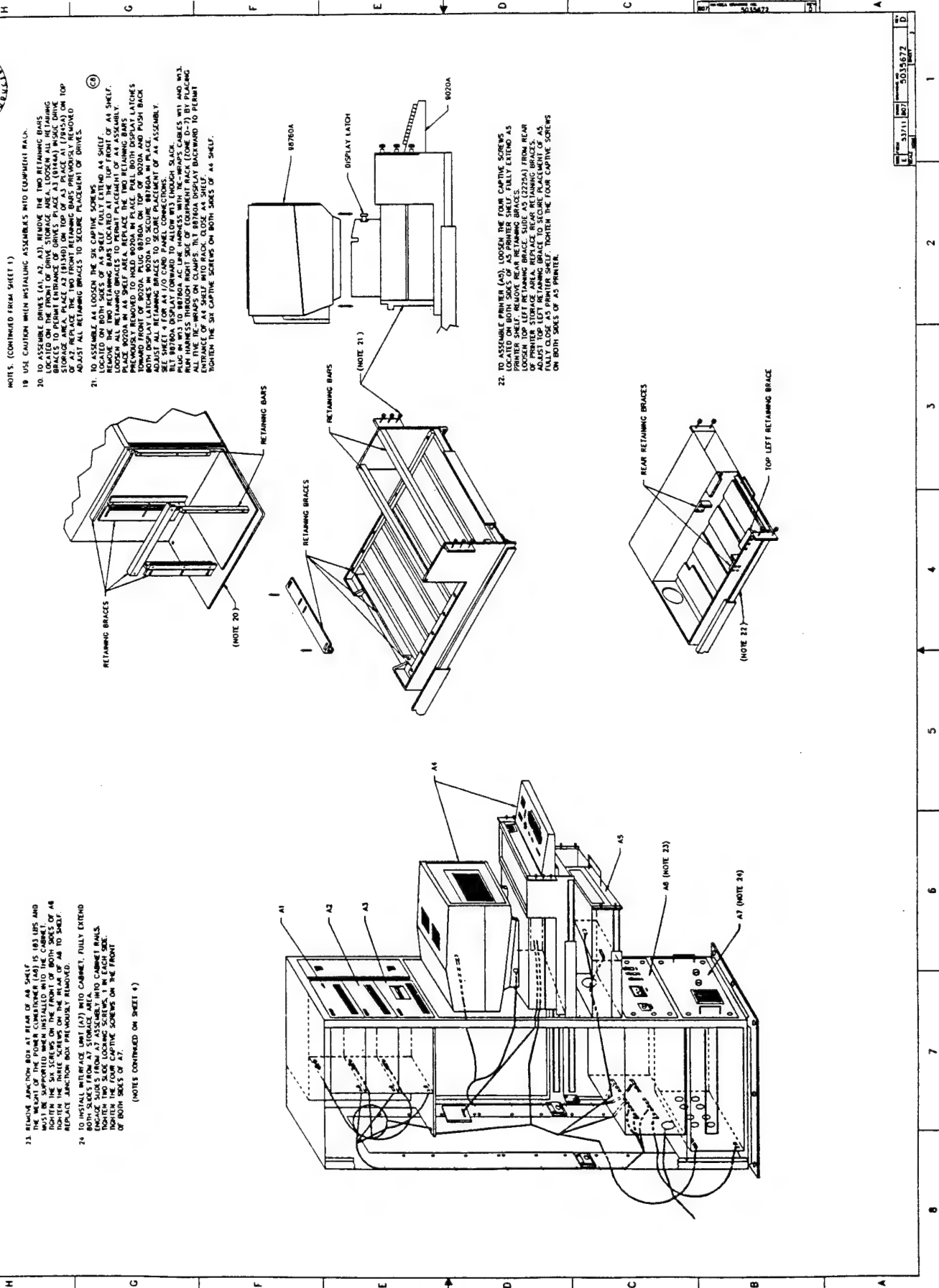
VIEW B-B
ENLARGED
POWER CONDITIONER
MUST BE REMOVED FROM
CABINET TO CONNECT SHIPS
POWER. SEE NOTE 13 C-C.
NOTE 231 SEE SH 1



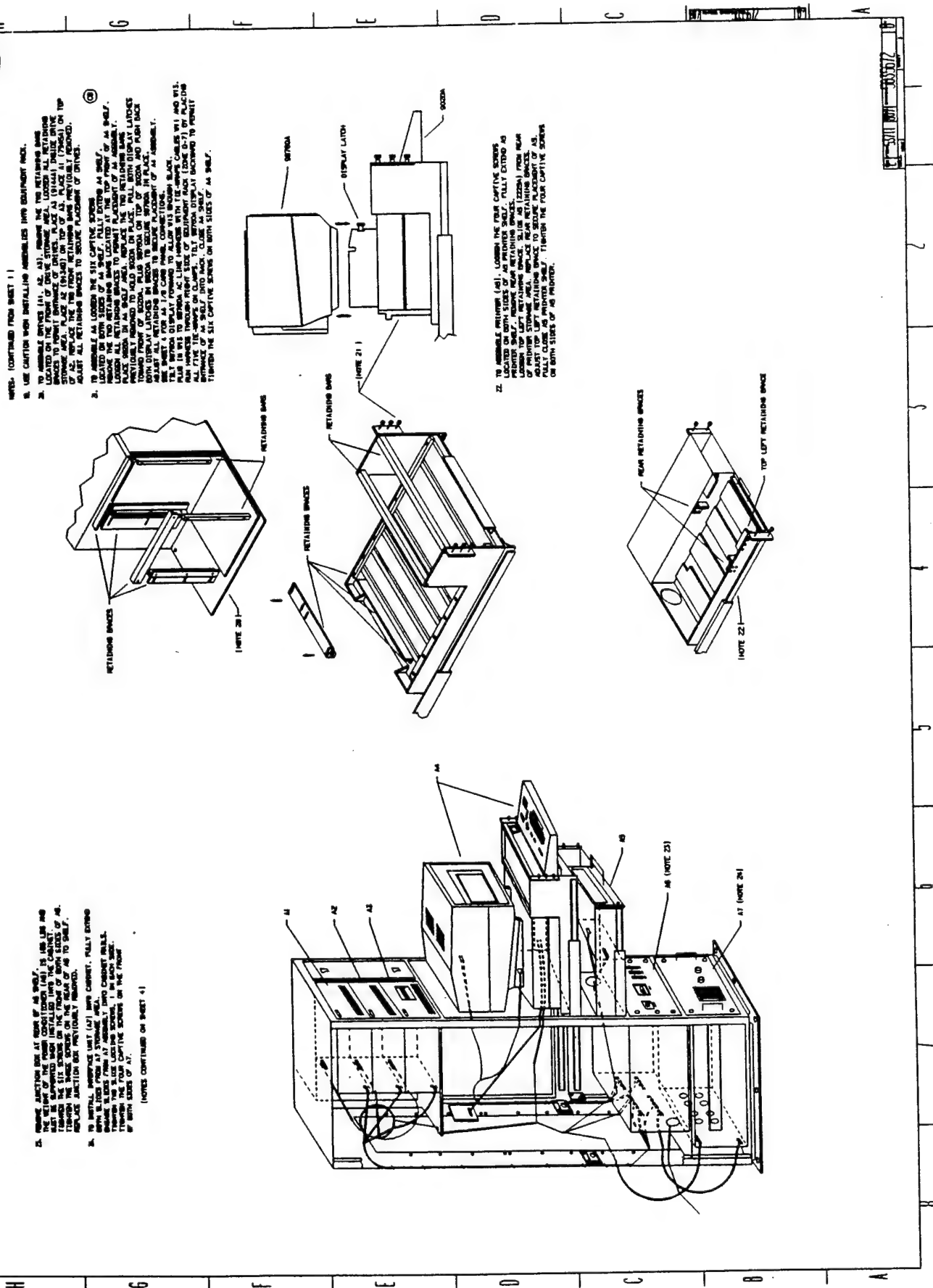
Sheet 3

The following three plots are:

1. Installation Control Drawing Sheet 3 as originally drawn by Tracor on AutoCAD.
2. Sheet 3 graphics as stored in the IGES file pre-processed by Tracor's AutoCAD.
3. Sheet 3 as displayed by the Engineering Station's Anvil system after post-processing the IGES file.



33



Sheet 4

The following three plots are:

1. Installation Control Drawing Sheet 4 as originally drawn by Tracor on AutoCAD.
2. Sheet 4 graphics as stored in the IGES file pre-processed by Tracor's AutoCAD.
3. Sheet 4 as displayed by the Engineering Station's Anvil system after post-processing the IGES file.



NOTES (CONTINUED FROM SHEET 3)

25. A1, A2, A3 CABLES MUST BE CONNECTED IN THE FOLLOWING ORDER:

CABLE NO.	DESTINATION
W3	A2 HP-IB
W4	A2 HP-IB
W5	A1 HP-IB
W6	A1 HP-IB
W7	A3 HP-IB
W8	A3 HP-IB
W9	A1 AC LINE
W10	A3 AC LINE

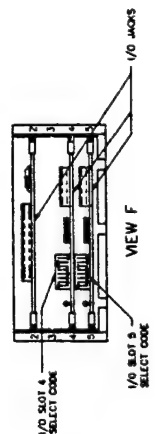
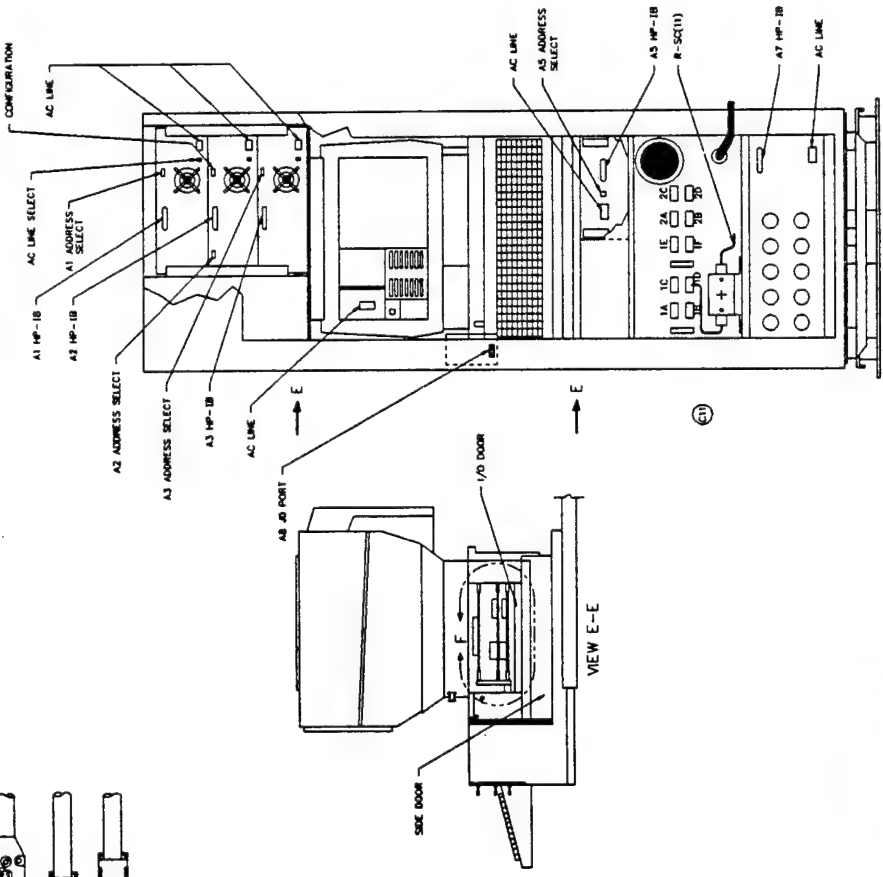
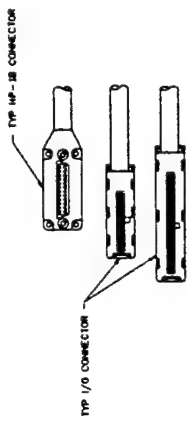
26. A4 CABLES MUST BE CONNECTED IN THE FOLLOWING ORDER:
PLUG W13 INTO INTERNAL AC LINE TO A4 FULLY EXTEND A4 SHELF (NEW E-E).
TURN ON POWER AND OPEN A4 SHELF. LOOSEN THE TWO CAPTIVE TRANSDUCERS.
ON I/O DOOR AND SWING DOOR OPEN PLUG W12 I/O CABLE INTO SLOT 2.
CLOSE I/O DOOR AND SWING DOOR. CLOSE A4 SHELF AND TIGHTEN CAPTIVE TRANSDUCERS.
CLOSE I/O DOOR AND TIGHTEN CAPTIVE TRANSDUCERS.

27. A5 CABLES MUST BE CONNECTED IN THE FOLLOWING ORDER:
PLUG W1 INTO A5 HP-IB. PLUG W10 INTO A5 AC LINE.

28. A6 CABLES MUST BE CONNECTED IN THE FOLLOWING ORDER:

CABLE NO.	DESTINATION
W11	A6 1C
W12	A6 1A
W13	A6 1B
W14	A6 1D
W15	A6 2A
W16	A6 2B
W17	A6 2C
W18	A6 2D

- 29. PLUG W4 INTO A7 HP-IB PORT
- 30. VERIFY AC LINE SELECTION AT A1, A2, A3 AND A4 IS SET AT 115V AND THAT A5 AC LINE SELECTION IS SET AT 120V
- 31. PLUG R-SQ(10) CABLE FROM UNIT 2 INTO I/O PORT AND CLAMP IT TO THE I/O PORT. CLAMP IT TO THE I/O PORT. CLAMP IT TO THE I/O PORT. CLAMP IT TO THE I/O PORT.
- 32. CONNECT 167 GROUND STRAP TO CABINET GROUND AND CONNECT GROUND STRAP 167/171/201 BETWEEN I/O AND CABINET GROUND.



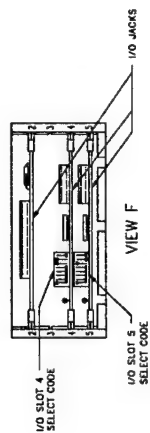
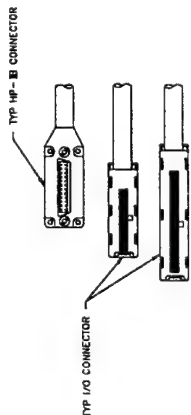
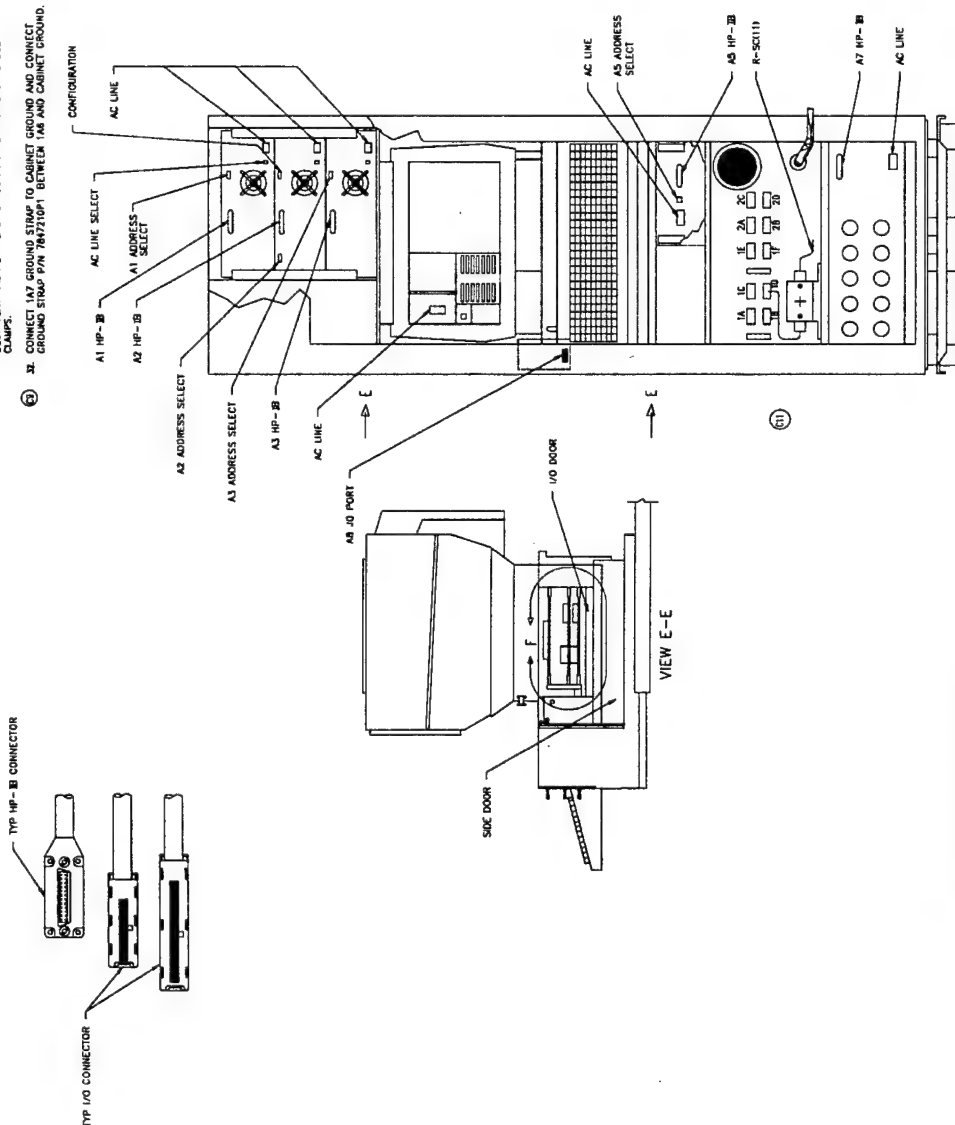
NOTES: (CONTINUED FROM SHEET 31)

25. A1, A2, A3 CABLES MUST BE CONNECTED IN THE FOLLOWING ORDER:
26. A4 CABLES MUST BE CONNECTED IN THE FOLLOWING ORDER:
27. A5 CABLES MUST BE CONNECTED IN THE FOLLOWING ORDER:
28. A6 CABLES MUST BE CONNECTED IN THE FOLLOWING ORDER:

CABLE NO.	DESTINATION
W3	A2 HP-B
W4	A2 HP-B
W5	A1 HP-B
W6	A1 HP-B
W7	A3 HP-B
W8	A1 AC LINE
W9	A2 AC LINE
W10	A3 AC LINE

25. A1, A2, A3 CABLES MUST BE CONNECTED IN THE FOLLOWING ORDER:
 26. A4 CABLES MUST BE CONNECTED IN THE FOLLOWING ORDER:
 27. A5 CABLES MUST BE CONNECTED IN THE FOLLOWING ORDER:
 28. A6 CABLES MUST BE CONNECTED IN THE FOLLOWING ORDER:

CABLE NO.	DESTINATION
W11	A8 1C
W12	A8 1A
W13	A8 1B
W14	A8 1D
W15	A8 2A
W16	A8 2B
W17	A8 2C
W18	A8 2D



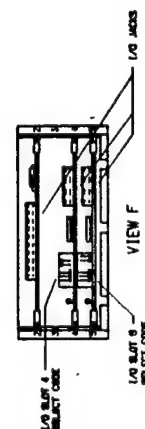
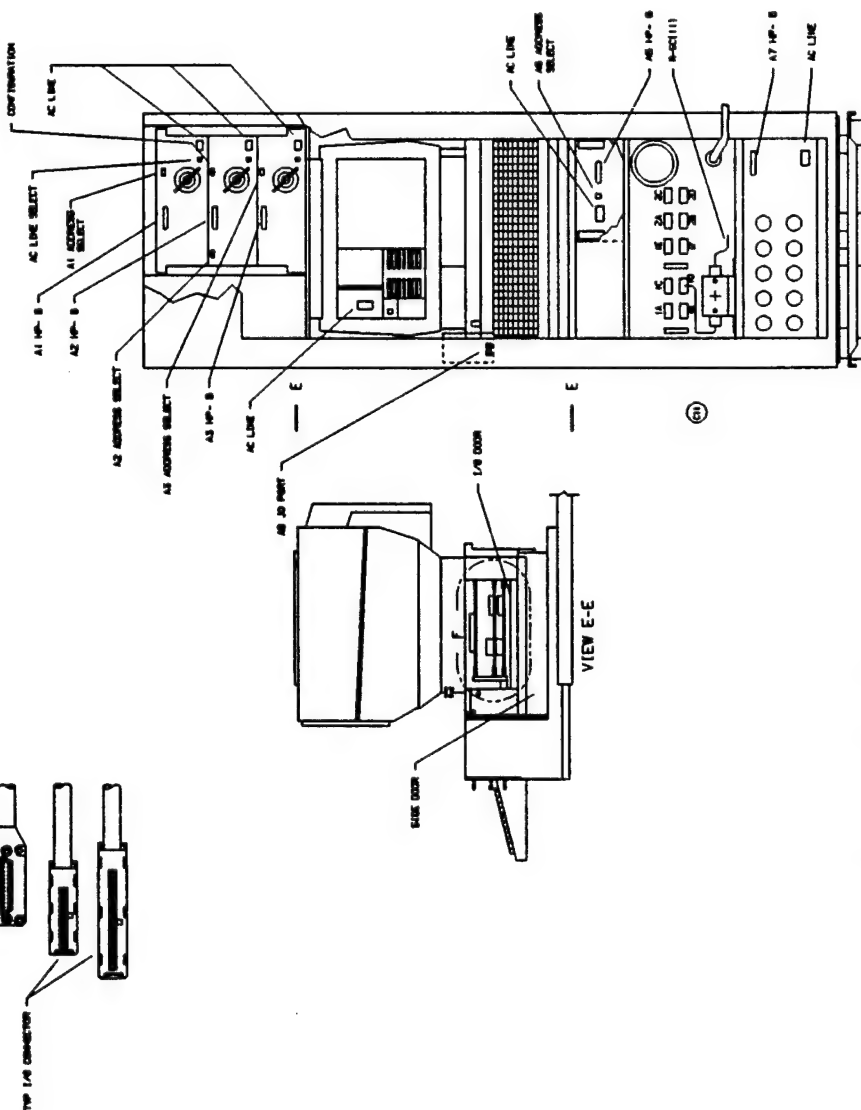


NOTES: (CONTINUED FROM SHEET 5)

2. A1, A2, A3 CABLES MUST BE CONNECTED IN THE FOLLOWING ORDER:
- | CABLE NO. | DESTINATION |
|-----------|-------------|
| W8 | A2 1P-18 |
| W9 | A2 1P-18 |
| W10 | A2 1P-18 |
| W11 | A1 1P-18 |
| W12 | A1 1P-18 |
| W13 | A3 1P-18 |
| W14 | A3 1P-18 |
| W15 | A3 1P-18 |
| W16 | A1 AC LINE |
| W17 | A1 AC LINE |
| W18 | A2 AC LINE |
| W19 | A3 AC LINE |
3. A4 CABLES MUST BE CONNECTED IN THE FOLLOWING ORDER:
- | CABLE NO. | DESTINATION |
|-----------|-------------|
| W20 | A4 1C |
| W21 | A4 1A |
| W22 | A4 1B |
| W23 | A4 1B |
| W24 | A4 1B |
| W25 | A4 2A |
| W26 | A4 2B |
| W27 | A4 2C |
| W28 | A4 2C |
| W29 | A4 2D |
4. A5 CABLES MUST BE CONNECTED IN THE FOLLOWING ORDER:
- | CABLE NO. | DESTINATION |
|-----------|-------------|
| W30 | A5 1C |
| W31 | A5 1A |
| W32 | A5 1B |
| W33 | A5 1B |
| W34 | A5 1B |
| W35 | A5 2A |
| W36 | A5 2B |
| W37 | A5 2C |
| W38 | A5 2C |
| W39 | A5 2D |

5. PLUS W8 WIRE AT 1P-18 PORT.
6. VERIFY AC LINE SELECTION AT A1, A2, A3 AND A4 IS SET AT 115V.
7. PLUS W12 (18) CABLE FROM UNIT 2 DOWN LINE 1P-18 PORT AND CONNECT TO A1 1P-18 PORT. PLUS W13 (18) CABLE FROM UNIT 2 DOWN LINE 3P-18 PORT AND CONNECT TO A3 1P-18 PORT. PLUS W14 (18) CABLE FROM UNIT 2 DOWN LINE 3P-18 PORT AND CONNECT TO A3 1P-18 PORT. PLUS W15 (18) CABLE FROM UNIT 2 DOWN LINE 3P-18 PORT AND CONNECT TO A3 1P-18 PORT. PLUS W16 (18) CABLE FROM UNIT 2 DOWN LINE 1P-18 PORT AND CONNECT TO A1 AC LINE. PLUS W17 (18) CABLE FROM UNIT 2 DOWN LINE 1P-18 PORT AND CONNECT TO A1 AC LINE. PLUS W18 (18) CABLE FROM UNIT 2 DOWN LINE 1P-18 PORT AND CONNECT TO A2 AC LINE. PLUS W19 (18) CABLE FROM UNIT 2 DOWN LINE 1P-18 PORT AND CONNECT TO A3 AC LINE.
8. CONNECT A3 WIRE TO CABLE RING AND CONNECT TO CABLE RING STRAP FROM W122091 BETWEEN A1 AND CABLE RING.

TYPE 1P-18 CONNECTOR



3.2.1.1 28000 Conformance of AutoCAD's IGES

First, the table shows that the IGES files AutoCAD created did not conform to 28000 because they were missing the required Drawing and Drawing Property Entities. Furthermore, the files contained text of a non-allowed text font and Composite Curve Entities made up of only one curve. All problems were attributed to AutoCAD's IGES pre-processor.

The missing Drawing and Drawing Property Entities bring up an interesting point. 28000 requires these entities, yet AutoCAD, like many microcomputer-based CAD systems, does not inherently have the "Drawing" concept in its drafting package. CALS faces a sizable decision regarding CAD packages with less inherent sophistication than the specification allows. Should the Office of the Secretary of Defense (OSD) CALS Policy Office ask microcomputer-based systems to bring their CAD packages up to 28000 levels (possibly an impossible task), or create another subset for less capable systems?

3.2.1.2 Correct Syntax of AutoCAD's IGES

Next, the table shows that AutoCAD incorrectly set the Line Font Field of the Directory Entry Section to zero for certain entities. This is an AutoCAD pre-processor syntax error.

3.2.1.3 Correct Graphics of AutoCAD's IGES

Finally, AutoCAD's IGES files did not correctly contain representations of all of the original graphics drafted by Tracor. Problems included large title block text, incorrectly written special characters (for example, the degree or plus and minus symbols), and improperly filled arrowheads and shaded areas. The plots display these graphical problems. The large title block text was caused by Tracor's use of a special shape font which AutoCAD's processor did not properly translate into IGES. The special characters were incorrectly generated because AutoCAD does not make use of the

special character font that IGES and 28000 allows. The inaccurate and missing fill is an AutoCAD software bug.

3.2.1.4 Correct Display of Graphics by Anvil

The last section of Table I lists the graphical problems uncovered after the complete end-to-end transfer of the engineering drawing sheets and their display on the Engineering Station's Anvil system. The AutoCAD problems still existed, but in addition, Anvil produced several more graphical errors while post-processing the IGES file. Those problems included missing circles on the revision notes, missing large filled arrows, missing arrowheads from the small arrows, and various missing details (those saved as subfigures or blocks). All were attributed to Anvil's non-processing of three entities: the Copious Data Simple Closed Area, the Subfigure Instance, and the Subfigure Definition Entities. MCS Inc. claims it has added the support of both these entities to its new version (Release 2.0) of Anvil 5000.

To make present use of the data, the Engineering Station and Tracor discussed a work around that would eliminate most of these problems. It involved exploding all closed area and subfigure data at Tracor before pre-processing the file. This would eliminate these entities from the IGES file, therefore Anvil could properly generate the graphics, but on the down side, this procedure would also create a larger file.

3.2.2 Preparatory CTN Reference Drawing Testing

As preparatory work to the end-to-end test using the actual engineering drawing, Tracor and the Engineering Station transferred the CTN Reference Drawings. This transfer involved following the pre-processor scripts on AutoCAD to develop the reference drawings, pre-processing them to IGES, and post-processing them into Anvil to answer the questions in the evaluation scripts. A second test involved purely a single-ended test with Anvil and the CTN platform. This was done to determine the capabilities of Anvil.

Results of the end-to-end and the single-ended reference drawing tests are shown in Appendix B and C respectively. Results include a table describing by entity number, which 28000 entities of the "N-entity" and "L-bracket" drawings were processed by each processor, and if not, where the problem was attributed. Plots also accompany the tables to graphically display the entities that were pre- and post-processed. To explain the pre-processed "N-entity" drawings, the entities occupy a square only if the translator pre-processed them into the IGES file. If an entity was not used by the drafting package or IGES translator or mapped to a different entity instead, the square was left blank. Thus, in the case of AutoCAD which pre-processes only a few IGES entities the drawing appears empty, but as demonstrated in the actual engineering drawing testing the system is able to transfer most of the graphical information necessary for a typical drawing. The plots show that Anvil translated a fair number of the 28000 entities well.






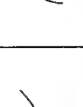
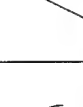




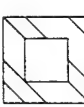



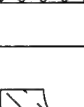
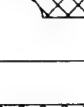
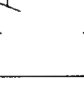


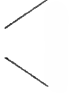



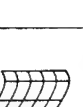

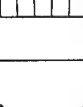

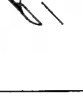






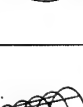


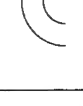




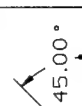
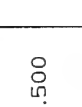
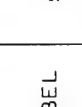
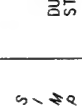
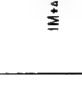
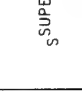

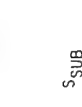

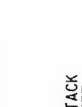

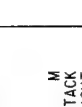
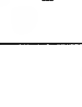
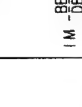
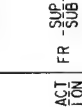
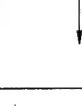




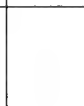
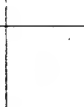
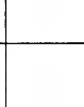


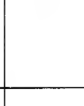

4 Conclusions and Recommendations

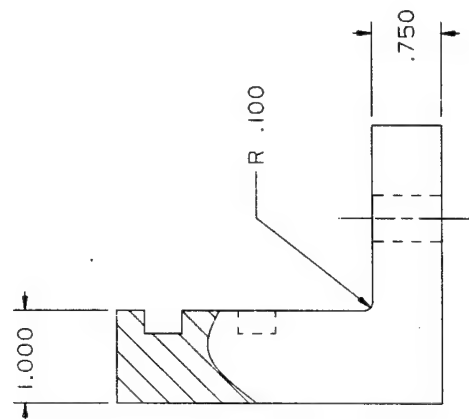
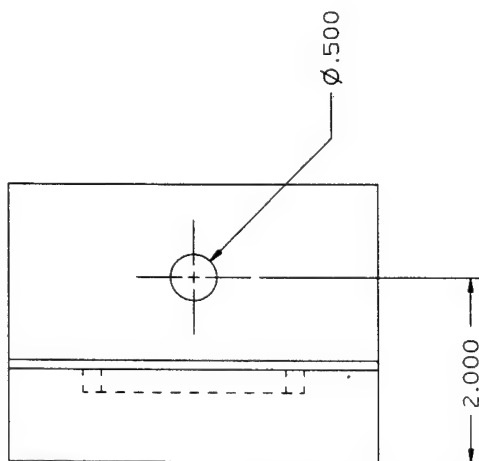
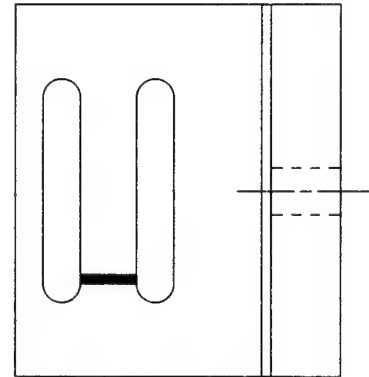
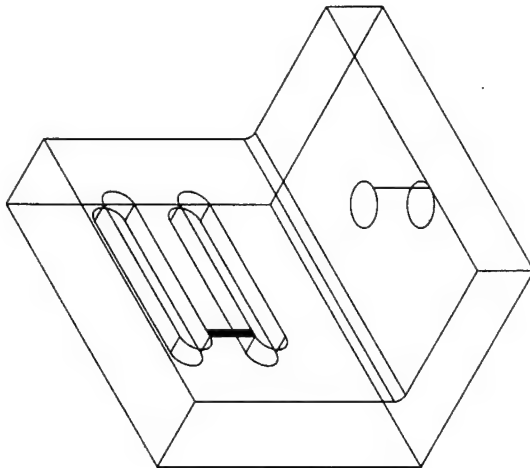
Overall, the results of the end-to-end test were good and the preparatory testing useful. Tracor and the Engineering Station were pleased to learn about work arounds for the present problems and to receive commitments from the vendors for better and more 28000 support in the future. Autodesk Inc. issued a verbal corporate statement that it intends to support CALS to the extent possible given its microcomputer-based technology. In the meantime, Autodesk hopes that this microcomputer technology will improve and/or that the standards making committees will recognize the importance microcomputers have in today's industry and revise the standards to reflect this. Furthermore, MCS, Inc. corporately announced in writing its intent to support CALS, including the creation of 28000-subset-compliant processors to help the users directly meet the CALS requirements. As a result of the testing, the CTN technical staff recommends that:

1. 1840A be modified to clarify what is required within document identifiers and to address identifiers for multiple sheeted engineering drawings. Possible solutions may come from the upcoming CTN large volume transfer tests.
2. The words concerning the transfer media requirements be removed from 1840A and placed in new CALS specifications governing an expanded list of transfer media.
3. The OSD CALS Policy Office begin to study an approach for allowing limited microcomputer-based CAD systems to become more easily CALS compliant, possibly looking into a new subset or application protocol.
4. Autodesk, Inc. continue to improve its AutoCAD IGES processors and to allow for user-created Start Sections.
5. MCS, Inc. continue to improve its Anvil IGES processors to support more 28000 entities.

Appendix A

Plots of the standard CALS Test Network MIL-D-28000 Class II Reference Drawings "N-entity" and "L-bracket"

									
CIRCULAR ARC (1001)	COMPOSITE CURVE (102)	CONIC ARC - GENERAL (104 FORM 01)	CONIC ARC - ELLIPSE (104 FORM 1)	CONIC ARC - HYPERBOLA (104 FORM 2)	CONIC ARC - PARABOLA (104 FORM 3)	LINEAR PLANAR CURVE (106 FORM 1)	COORDINATE TRIPLES (106 FORM 1)	CENTERLINE THRU POINTS (106 FORM 2)	CENTERLINE THRU CENTER (106 FORM 3)
									
SECTION 31 (106 FORM 31)	SECTION 32 (106 FORM 32)	SECTION 33 (106 FORM 33)	SECTION 34 (106 FORM 34)	SECTION 35 (106 FORM 35)	SECTION 36 (106 FORM 36)	SECTION 37 (106 FORM 37)	SECTION 38 (106 FORM 38)	WITNESS LINE (106 FORM 40)	SIMPLE CLOSED AREA (106 FORM 63)
									
UNBOUNDED PLANE (108 FORM 01)	BOUNDED PLANE (108 FORM 1)	LINE (110)	PARAMETRIC SPLINE CURVE (112)	PARAMETRIC SPLINE SURFACE (114)	POINT (116)	RULED SURFACE - ARC (118 FORM 0)	RULED SURFACE - PARAMETRIC (118 FORM 1)	SURFACE OF REVOLUTION (120)	TABULATED CYLINDER (122)
									
TRANSFORMATION MATRIX (112 FORM 0)	TRANSFORMATION MATRIX (112 FORM 1)	RATIONAL B-SPLINE CURVE (116 FORM 0)	RATIONAL B-SPLINE SURFACE (116 FORM 1)	RBS RIGHT CIRCULAR CYLINDER (118 FORM 2)	RBS CONE (118 FORM 3)	RBS SPHERE (118 FORM 4)	RBS TORUS (118 FORM 5)	RBS GENERAL QUADRATIC (118 FORM 9)	OFFSET CURVE (120)
									
OFFSET SURFACE (140)	CURVE ON PARAMETRIC SURFACE (142)	TRIMMED PARAMETRIC SURFACE (144)	ANGULAR DIMENSION (122)	DIAMETER DIMENSION (126)	LABEL (120)	SIMPLE (122 FORM 0)	DUAL STACK (122 FORM 1)	IMAGED (122 FORM 3)	SUPER (122 FORM 3)
									
LEADER - TRIANGLE (124 FORM 2)	LEADER - FILLED TRIANGLE (124 FORM 3)	LEADER - NO ARROW (124 FORM 4)	LEADER - CIRCLE (124 FORM 5)	LEADER - FILLED CIRCLE (124 FORM 6)	LEADER - RECTANGLE (124 FORM 7)	LEADER - FILLED RECTANGLE (124 FORM 8)	LEADER - DASH (124 FORM 9)	LEADER - INTERPOL (124 FORM 10)	LEADER - OPEN TRIANGLE (124 FORM 11)
LEADER - TRIANGLE (124 FORM 2)	LEADER - FILLED TRIANGLE (124 FORM 3)	LEADER - NO ARROW (124 FORM 4)	LEADER - CIRCLE (124 FORM 5)	LEADER - FILLED CIRCLE (124 FORM 6)	LEADER - RECTANGLE (124 FORM 7)	LEADER - FILLED RECTANGLE (124 FORM 8)	LEADER - DASH (124 FORM 9)	LEADER - INTERPOL (124 FORM 10)	LEADER - OPEN TRIANGLE (124 FORM 11)
									
LINEAR DIMENSION (128)	ORDINATE DIMENSION (130)	POINT DIMENSION (132)	RADIUS DIMENSION (134)	SYMBOL - GENERAL (128 FORM 0)	SYMBOL - DATUM (128 FORM 1)	SYMBOL - FEATURE CONTROL (128 FORM 3)	SECTIONED AREA (128)	CALS TEST NETWORK (MIL-D-28000 CLASS II) (128 FORM 1)	CALS TEST NETWORK (MIL-D-28000 CLASS II) (128 FORM 1)



CTN L-bracket Reference Drawing

Appendix B

Results of the preparatory end-to-end test between Tracor and the Engineering Station using the reference drawings

Table:

Table B-I describes by entity name and number which 28000 entities of the "N-entity" and "L-bracket" drawings were processed during the end-to-end transfer between Tracor and the Engineering Station.

Plots:

Tracor's Original N-entity Drawing = displays the "N-entity" drawing as drafted on AutoCAD.

Tracor's N-entity IGES Representation = displays the graphics represented in the IGES file pre-processed by AutoCAD.

Engineering Station's Display of N-entity IGES File = shows what entities present in the IGES file were displayed on the Engineering Station's Anvil system.

Tracor's Original L-bracket Drawing = displays the "L-bracket" drawing as drafted on AutoCAD.

Tracor's L-bracket IGES Representation = displays the graphics represented in the IGES file pre-processed by AutoCAD.

Engineering Station's Display of L-bracket IGES File = shows what entities present in the IGES file were displayed on the Engineering Station's Anvil system.

Table B-I
End-to-end Processing of MIL-D-28000 Class II Entities
Between Tracor and the Engineering Station

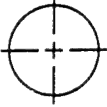
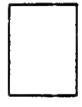

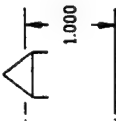

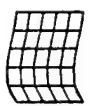








Entity Number	Form Number	Entity Name	Pre-processed from AutoCAD	If no, where attributed	If pre-processed, then post-processed into Anvil	If no, where attrib.
100		Circular Arc	yes	-	yes	-
102		Composite Curve	part	AD	yes	-
104	0	Conic Arc-General	no	AD	-	-
104	1	Conic Arc-Ellipse	no	AP	-	-
104	2	Conic Arc-Hyperbola	no	AD	-	-
104	3	Conic Arc-Parabola	no	AD	-	-
106	11	Linear Planar Curve	no	AP	-	-
106	12	Coordinate Triples	yes	-	yes	-
106	20	Centerline Thru Point	no	AP	-	-
106	21	Centerline Thru Centr	yes	-	yes	-
106	31	Section Form 31	no	AP	-	-
106	32	Section Form 32	no	AP	-	-
106	33	Section Form 33	no	AP	-	-
106	34	Section Form 34	no	AP	-	-
106	35	Section Form 35	no	AP	-	-
106	36	Section Form 36	no	AP	-	-
106	37	Section Form 37	no	AP	-	-
106	38	Section Form 38	no	AP	-	-
106	40	Witness Line	part	AD	yes	-
106	63	Simple Closed Area	yes	-	no	NP
108	0	Unbounded Plane	no	AD	-	-
108	1	Bounded Plane	no	AP	-	-
110		Line	yes	-	yes	-
112		Param Spline Curve	no	AP	-	-
114		Param Spline Surface	yes	-	yes	-
116		Point	yes	-	yes	-
118	0	Ruled Surf-Arc Lngth	no	AP	-	-
118	1	Ruled Surf-Param	no	AP	-	-
120		Surface of Revolution	no	AP	-	-
122		Tabulated Cylinder	yes	-	yes	-
124	0	Transf Matrix D = 1	yes	-	yes	-
124	1	Transf Matrix D = -1	no	AP	-	-
126	0	Rat B-Spline Curve	no	AP	-	-

Entity Number	Form Number	Entity Name	Pre-processed from AutoCAD	If no, where attributed	If pre-processed, then post-processed into Anvil	If no, where attrib.
128	0	Rat B-Spline Surface	no	AP	-	-
128	2	RBS Rt Circ Cylinder	no	AP	-	-
128	3	RBS Cone	no	AP	-	-
128	4	RBS Sphere	no	AP	-	-
128	5	RBS Torus	no	AP	-	-
128	9	RBS General Quadratic	no	AP	-	-
130		Offset Curve	no	AP	-	-
140		Offset Surface	no	AD	-	-
142		Curve on Param Surf	no	AD	-	-
144		Trimmed Param Surf	no	AD	-	-
202		Angular Dimension	part	AP	yes	-
206		Diameter Dimension	part	AP	part	NP
210		General Label	no	AP	-	-
212	0	General Note-Simple	part	AP	part	NP
212	1	Note-Dual Stack	no	AP	-	-
212	2	Note-Imbed Font Chnge	no	AP	-	-
212	3	Note-Superscript	no	AD	-	-
212	4	Note-Subscript	no	AD	-	-
212	5	Note-Super/Subscript	no	AD	-	-
212	6	Note-Mu Stack Lf Just	no	AP	-	-
212	7	Note-Mu Stack Ct Just	no	AP	-	-
212	8	Note-Mu Stack Rt Just	no	AP	-	-
212	100	Note-Simple Fraction	no	AD	-	-
212	101	Note-Dual Stack Fract	no	AD	-	-
212	102	Note-Font/Dble Fract	no	AD	-	-
212	105	Note-Super/Sub Fract	no	AD	-	-
214	1	Leader-Wedge	no	AD	-	-
214	2	Leader-Triangle	no	AD	-	-
214	3	Leader-Fill Triangle	no	T	-	-
214	4	Leader-No Arrow	no	T	-	-
214	5	Leader-Circle	no	AD	-	-
214	6	Leader-Filled Circle	no	T	-	-
214	7	Leader-Rectangle	no	AD	-	-
214	8	Leader-Fill Rectangle	no	AD	-	-
214	9	Leader-Slash	no	T	-	-
214	10	Leader-Integral Sign	no	AD	-	-
214	11	Leader-Open Triangle	no	AP	-	-
216		Linear Dimension	yes	-	part	NP
218		Ordinate Dimension	no	AD	-	-
220		Point Dimension	no	AD	-	-




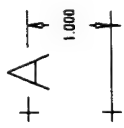





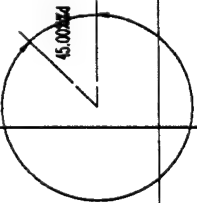






Entity Number	Form Number	Entity Name	Pre-processed from AutoCAD	If no, where attributed	If pre-processed, then post-processed into Anvil	If no, where attrib.
222		Radius Dimension	yes	-	yes	-
228	0	Symbol-General	no	AD	-	-
228	1	Symbol-Datum Feature	no	AD	-	-
228	2	Symbol-Datum Target	no	AD	-	-
228	3	Symbol-Feature Contrl	no	AD	-	-
230		Sectioned Area	no	AP	-	-
304	1	Line Font-Rept Subfig	no	AP	-	-
304	2	Line Font-Rept Vs/bnk	yes	-	yes	-
308		Subfigure Definition	yes	-	no	NP
314		Color Definition	no	AP	-	-
402	3	Views Visible	no	AD	-	-
402	4	View Vble/Color/Line	no	AD	-	-
402	15	Ordr Group wo B Point	no	AD	-	-
404		Drawing	no	AD	-	-
406	1	Definition Levels	no	AD	-	-
406	3	Level Function	no	AP	-	-
406	5	Line Widening	no	AP	-	-
406	15	Name	no	AD	-	-
406	16	Drawing Size	no	AD	-	-
406	17	Drawing Units	no	AD	-	-
408		Subfigure Instance	yes	-	no	NP
410		View	no	AD	-	-

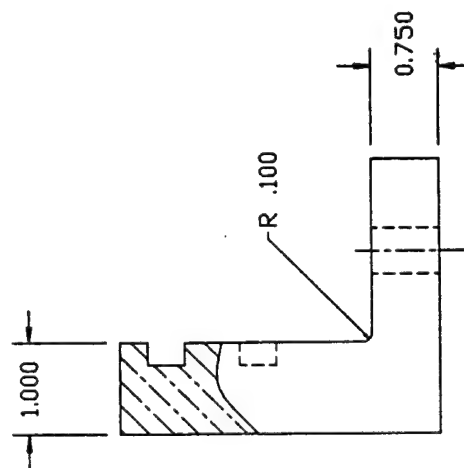
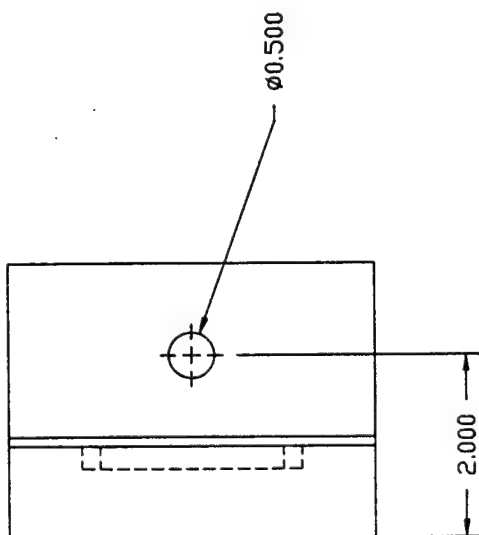
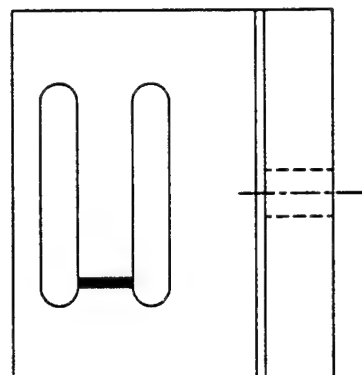
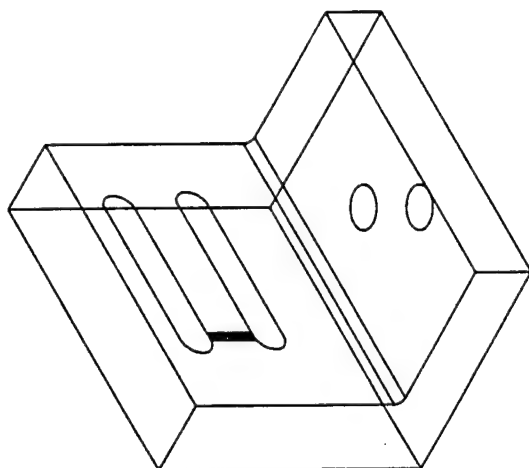
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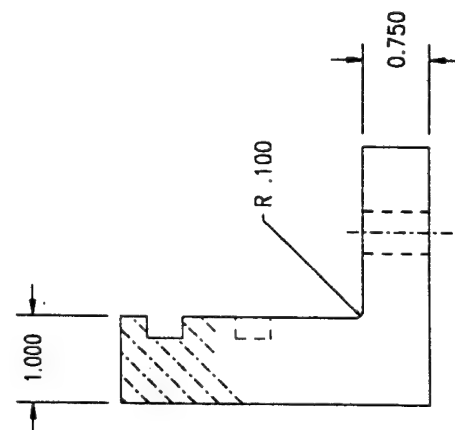
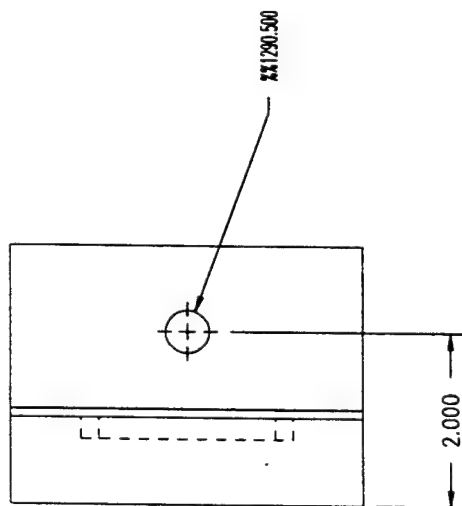
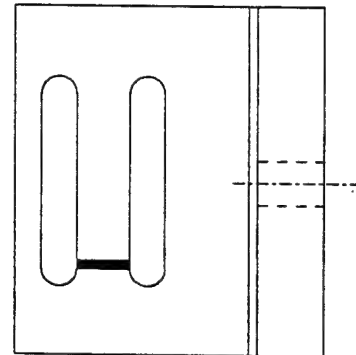
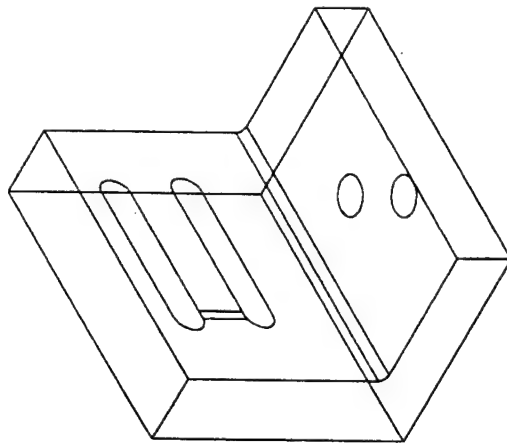
- yes = entity maintained its intent and functionality upon pre- or post-processing
- part = entity maintained partial intent or functionality and/or was able to transfer part of the information
- no = entity was not translated
- AD = entity could not be created by AutoCAD's drafting package, therefore not translated
- AP = entity incorrectly or not translated by AutoCAD's IGES pre-processor
- T = entity could not be created by AutoCAD's drafting package as described in the test case generation script, therefore entity not tested
- ND = entity could not be created by Anvil's drafting package, therefore not translated
- NP = entity incorrectly or not translated by Anvil's IGES post-processor
- = not applicable

							CALS TEST NETWORK RELEASED CLASS II REFERENCE DRAWING N-ENTITY
							
							
				SIMPLE M-J-10-91			
							
							
							
							
							

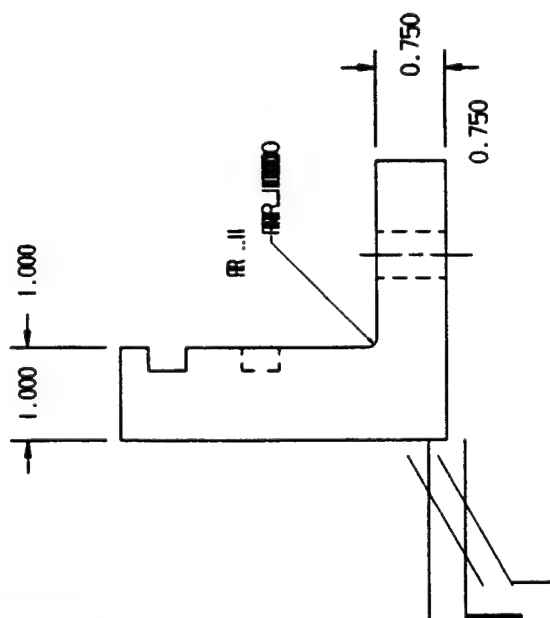
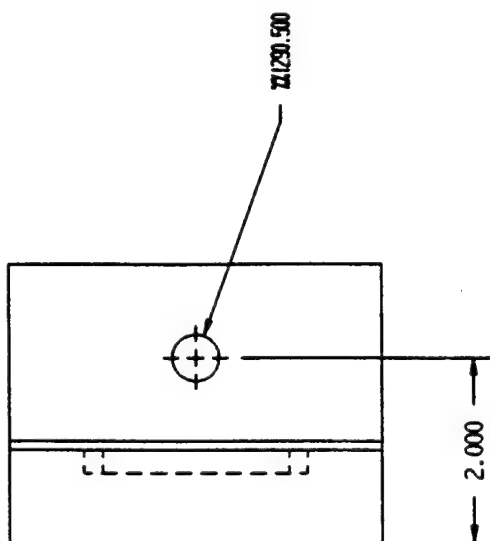
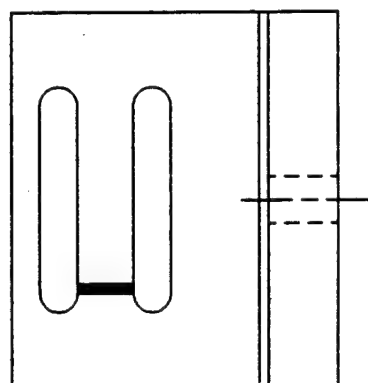
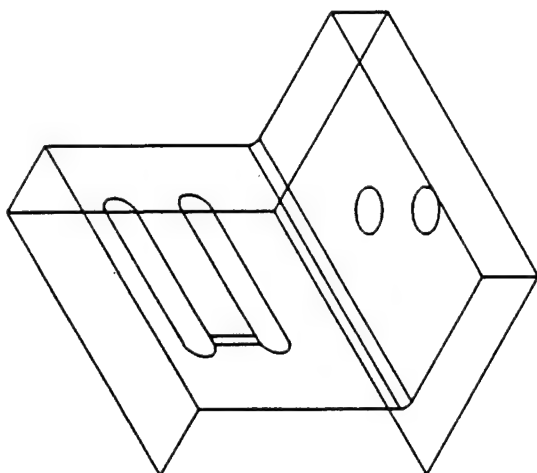
Tracor's Original N-Entity Drawing

								"CAL'S TEST NETWORK M-C-D-20000 CAL'S TEST NETWORK REFERENCE DRAWING N-ENTITY"
								
								
								
								
								
								
								
								
								





CTN Test Report 89-014
October 10, 1989



Appendix C

Results of the preparatory single-ended test with the Engineering Station's Anvil system using the reference drawings

Table:

Table C-I describes by entity name and number which 28000 entities of the "N-entity" and "L-bracket" drawings were processed by the Engineering Station's Anvil system.

Plots:

Anvil N-entity Before Pre-processing = displays the 28000
"N-entity" entities Anvil created to pre-processes into IGES.

Anvil N-entity IGES Representation = displays the graphics represented in Anvil's pre-processed IGES file.

Anvil L-bracket Before Pre-processing = displays the "L-bracket" drawing Anvil created to pre-processes into IGES.

Anvil L-bracket IGES Representation = displays the graphics represented in Anvil's pre-processed IGES file.

Anvil N-entity After Post-processing = displays the "N-entity" entities post-processed by Anvil.

Anvil L-bracket After Post-processing = displays the "L-bracket" drawing after post-processing by Anvil.

Table C-I
The Ability of Anvil 5000 to Pre- and Post-process
the MIL-D-28000 Class II Entities

Entity Number	Form Number	Entity Name	Pre- process from Anvil	If no, where attributed	Post- process into Anvil	If no, where attributed
100		Circular Arc	yes	-	yes	-
102		Composite Curve	part	DP	part	P
104	0	Conic Arc-General	no	P	yes	-
104	1	Conic Arc-Ellipse	yes	-	yes	-
104	2	Conic Arc-Hyperbola	yes	-	yes	-
104	3	Conic Arc-Parabola	yes	-	yes	-
106	11	Linear Planar Curve	yes	-	yes	-
106	12	Coordinate Triples	no	P	yes	-
106	20	Centerline Thru Point	yes	-	yes	-
106	21	Centerline Thru Centr	yes	-	yes	-
106	31	Section Form 31	yes	-	part	P
106	32	Section Form 32	part	P	part	P
106	33	Section Form 33	part	P	part	P
106	34	Section Form 34	part	P	map	D
106	35	Section Form 35	part	P	part	P
106	36	Section Form 36	part	P	yes	-
106	37	Section Form 37	yes	-	yes	-
106	38	Section Form 38	part	P	yes	-
106	40	Witness Line	part	D	part	P
106	63	Simple Closed Area	no	D	no	P
108	0	Unbounded Plane	part	D	yes	-
108	1	Bounded Plane	part	P	part	P
110		Line	yes	-	yes	-
112		Param Spline Curve	yes	-	yes	-
114		Param Spline Surface	yes	-	yes	-
116		Point	yes	-	yes	-
118	0	Ruled Surf-Arc Lngth	no	D	yes	-
118	1	Ruled Surf-Param	part	P	yes	-
120		Surface of Revolution	yes	-	yes	-
122		Tabulated Cylinder	yes	-	yes	-
124	0	Transf Matrix D = 1	yes	-	part	P

October 10, 1989

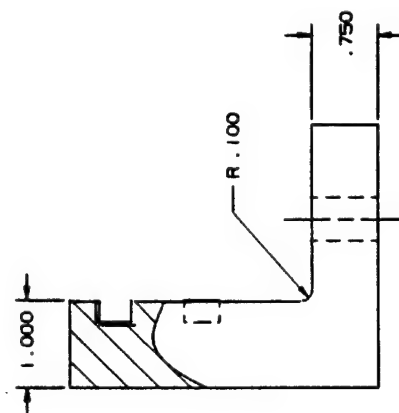
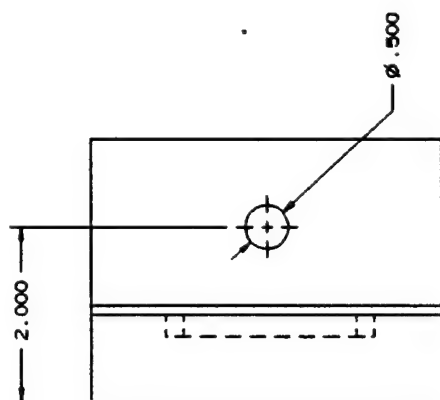
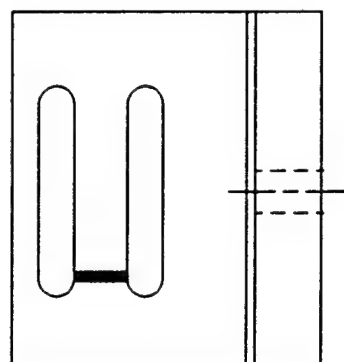
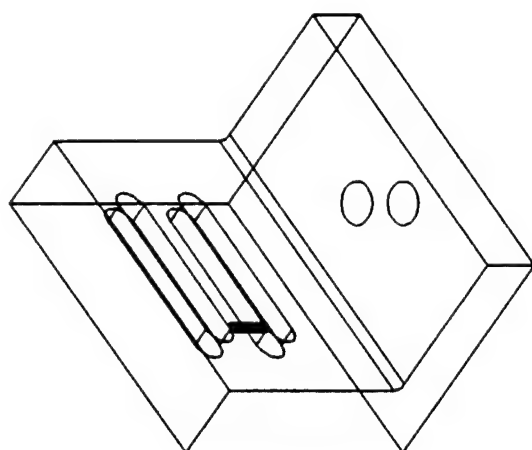
Entity Number	Form Number	Entity Name	Pre-process from Anvil	If no, where attributed	Post-process into Anvil	If no, where attributed
124	1	Transf Matrix D = -1	no	P	part	P
126	0	Rat B-Spline Curve	yes	-	part	S
128	0	Rat B-Spline Surface	yes	-	part	S
128	2	RBS Rt Circ Cylinder	no	P	part	S
128	3	RBS Cone	no	P	part	S
128	4	RBS Sphere	no	P	yes	-
128	5	RBS Torus	no	P	yes	-
128	9	RBS General Quadratic	no	P	part	S
130		Offset Curve	no	P	no	D
140		Offset Surface	no	P	no	P
142		Curve on Param Surf	no	P	yes	-
144		Trimmed Param Surf	no	P	part	P
202		Angular Dimension	yes	-	yes	-
206		Diameter Dimension	yes	-	part	P
210		General Label	yes	-	yes	-
212	0	General Note-Simple	part	D	part	P
212	1	Note-Dual Stack	no	P	yes	-
212	2	Note-Imbed Font Chnge	no	P	part	D
212	3	Note-Superscript	no	P	yes	-
212	4	Note-Subscript	no	P	yes	-
212	5	Note-Super/Subscript	no	P	yes	-
212	6	Note-Mu Stack Lf Just	no	P	yes	-
212	7	Note-Mu Stack Ct Just	no	D	yes	-
212	8	Note-Mu Stack Rt Just	no	D	yes	-
212	100	Note-Simple Fraction	yes	-	yes	-
212	101	Note-Dual Stack Fract	no	P	yes	-
212	102	Note-Font/Dble Fract	yes	-	part	D
212	105	Note-Super/Sub Fract	yes	-	yes	-
214	1	Leader-Wedge	yes	-	yes	-
214	2	Leader-Triangle	yes	-	yes	-
214	3	Leader-Fill Triangle	no	D	map	D
214	4	Leader-No Arrow	yes	-	yes	-
214	5	Leader-Circle	yes	-	part	P
214	6	Leader-Filled Circle	yes	-	yes	-
214	7	Leader-Rectangle	no	D	map	D
214	8	Leader-Fill Rectangle	no	D	map	D
214	9	Leader-Slash	no	D	map	D
214	10	Leader-Integral Sign	yes	-	yes	-

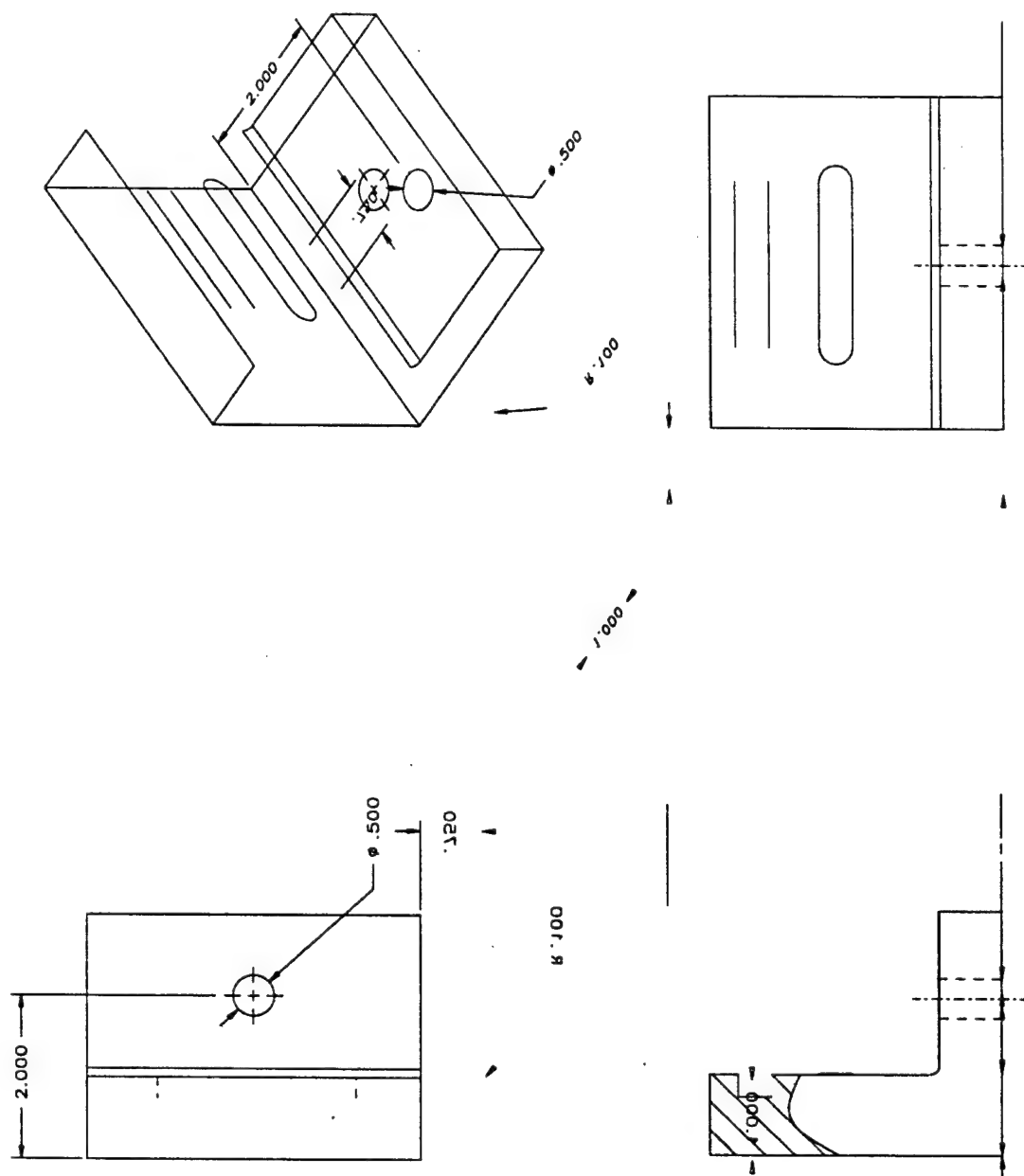
Entity Number	Form Number	Entity Name	Pre-process from Anvil	If no, where attributed	Post-process into Anvil	If no, where attributed
214	11	Leader-Open Triangle	no	D	map	D
216		Linear Dimension	yes	-	yes	-
218		Ordinate Dimension	yes	-	yes	-
220		Point Dimension	no	D	no	D
222		Radius Dimension	yes	-	yes	-
228	0	Symbol-General	yes	-	part	P
228	1	Symbol-Datum Feature	no	D	part	P
228	2	Symbol-Datum Target	no	D	part	P
228	3	Symbol-Feature Contrl	no	D	part	P
230		Sectioned Area	no	P	no	P
304	1	Line Font-Rept Subfig	no	P	?	-
304	2	Line Font-Rept Vs/bnk	yes	-	?	-
308		Subfigure Definition	no	P	no	P
314		Color Definition	no	P	no	P
402	3	Views Visible	no	P	?	-
402	4	View Vble/Color/Line	no	P	no	P
402	15	Ordr Group wo B Point	no	P	no	P
404		Drawing	part	P	part	P
406	1	Definition Levels	no	D	no	D
406	3	Level Function	no	P	no	P
406	5	Line Widening	no	P	no	P
406	15	Name	yes	-	yes	-
406	16	Drawing Size	yes	-	yes	-
406	17	Drawing Units	yes	-	yes	-
408		Subfigure Instance	no	P	no	P
410		View	yes	-	yes	-

KEY

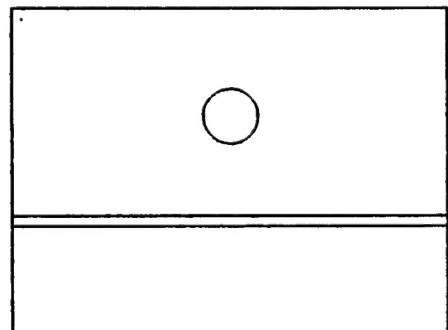
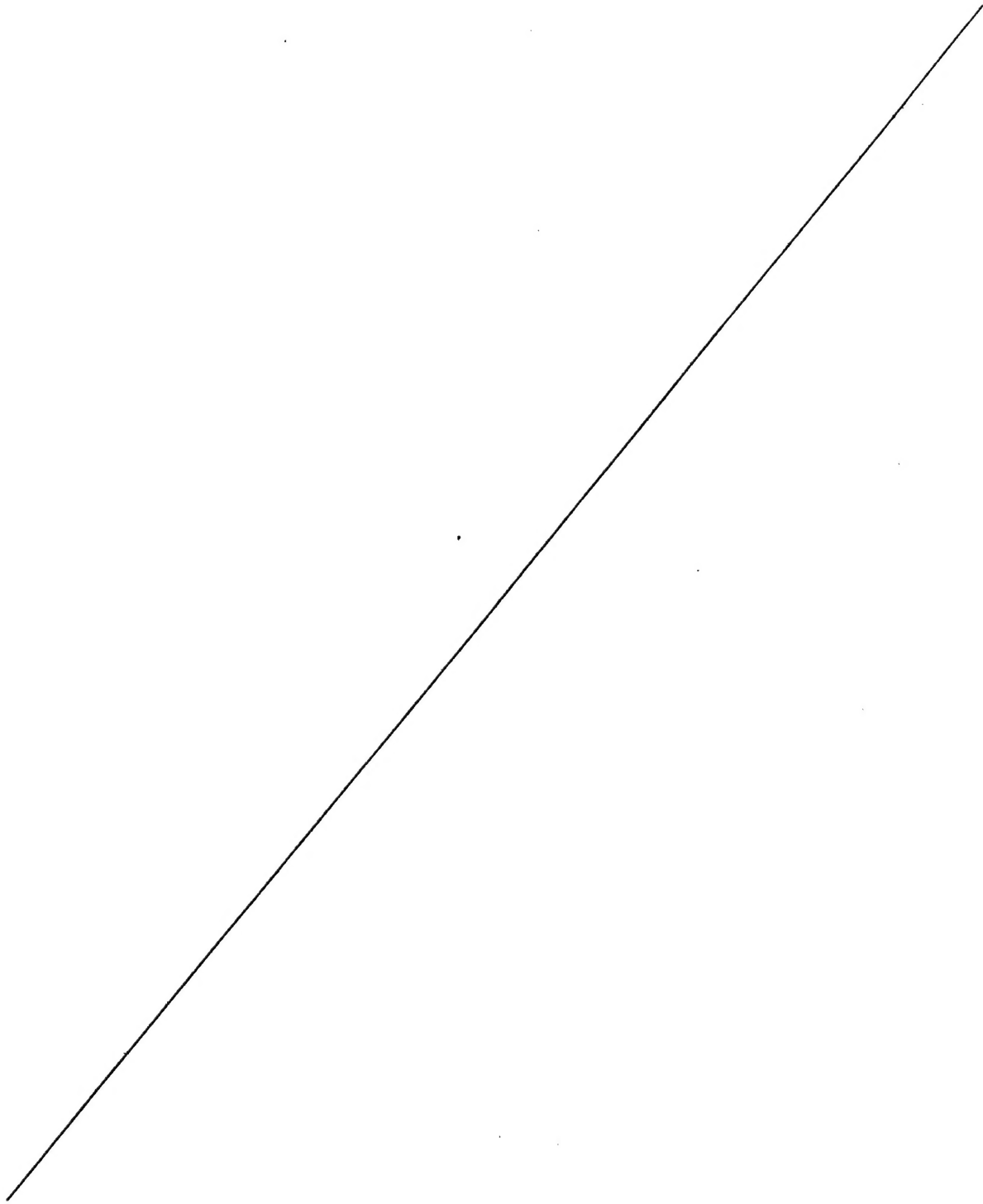
- yes = entity maintained its intent and functionality upon pre- or post-processing
- part = entity maintained partial intent or functionality and/or was able to transfer part of the information
- map = intended information was transferred into or by not specified entity, but a similar entity
- no = entity was not translated
- D = entity could not be created by Anvil's drafting package, therefore not translated
- P = entity was not or incorrectly translated by Anvil's IGES pre-processor
- S = data was transferred, but not properly displayed by Anvil's display code
- = not applicable
- ? = could not be determined due to incomplete post-processing of "L-bracket" drawing

								CALS TEST NETWORK MIL-D-28000 CLASSIFICATION REFERENCE DRAWING N-ENTITY
						BE AC IM ED ± FR ON		
				SIMPLE				
				LABEL	s6N			





Anvil L-bracket IGES Representation



Anvil L-bracket After Post-processing

Appendix D

References

- [CTN89] CALS Test Network Test Plans, Report 89-003, Lawrence Livermore National Laboratory, CALS Test Network.
- [FARR89] Farrell, J., The CALS Test Network MIL-D-28000 Class II Reference Drawing Packet, UCID 21622, Report 89-001, Lawrence Livermore National Laboratory, CALS Test Network, 1989.
- [NBS88] Initial Graphics Exchange Specification (IGES), Version 4.0, NBSIR 88-3813, U.S. National Bureau of Standards, 1988.
- [OSDA88] Automated Interchange of Technical Information, Military Standard MIL-STD-1840A Notice 1, OSD CALS Policy Office, 1988.
- [OSDD88] Digital Representation for Communication of Product Data: IGES Application Subsets, Military Specification MIL-D-28000 Amendment 1, OSD CALS Policy Office, 1988.